# Complete Summary

## GUIDELINE TITLE

HealthPartners Dental Group and Clinics caries guideline.

## BIBLIOGRAPHIC SOURCE(S)

HealthPartners Dental Group and Clinics caries guideline. Minneapolis (MN): HealthPartners Dental Group; 2008 Mar 31. 60 p. [328 references]

## GUIDELINE STATUS

This is the current release of the guideline.

## COMPLETE SUMMARY CONTENT



## SCOPE

### DISEASE/CONDITION(S)

Dental caries

### GUIDELINE CATEGORY

Diagnosis
Evaluation
Management
Prevention
Risk Assessment
Treatment

### CLINICAL SPECIALTY

Dentistry

### INTENDED USERS

Dentists

### GUIDELINE OBJECTIVE(S)

- To significantly reduce the incidence of caries in the HealthPartners Dental Group's patient population
- To provide methods to assess the individual's risk of developing caries, and focus on interventions that reduce that risk and the need for restorations

### TARGET POPULATION

Patients of all ages in the HealthPartners Dental Group

### INTERVENTIONS AND PRACTICES CONSIDERED

#### Diagnosis/Evaluation/Risk Assessment

1. Oral assessment and assignment of risk of developing dental caries
2. Radiographic and clinical examination
3. Other diagnostic techniques, including fluorescence from laser light, fiber optic transillumination
4. Monitoring of patient compliance with lifestyle changes and interventions

#### Prevention/Management/Treatment

1. Patient education on lifestyle changes for risk reduction
    - Nutrition counseling
    - Oral hygiene instruction
2. Remineralization (fluoride based therapy)
3. Restoration (glass ionomer, amalgam)
4. Prevention of caries or of progression
    - Sealants
    - Fluoride (fluids, community water, infant formula, toothpaste, mouthrinse, supplements, gels, varnishes)
    - Chlorhexidine
    - Xylitol
    - Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP)

### MAJOR OUTCOMES CONSIDERED

Not stated

## METHODOLOGY

### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

## DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Online searches were performed using MedLine, PubMed, and current journal articles.

## NUMBER OF SOURCE DOCUMENTS

Not stated

## METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

## METHODS USED TO ANALYZE THE EVIDENCE

Review
Review of Published Meta-Analyses

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Literature was reviewed and discussed by a committee of dentists.

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

## DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

## COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

## METHOD OF GUIDELINE VALIDATION

External Peer Review

### DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Not stated

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

#### Caries Risk Assessment for Children

HealthPartners Dental Group dentists and staff have the opportunity to significantly enhance the evaluation, risk assessment, and intervention of children for dental caries. The first step in this process is the oral evaluation/examination of the patient as early as possible. Current recommendations suggest that a child should have their first oral evaluation/examination no later than their first birthday. This oral evaluation/examination can be accomplished by means of a knee-to-knee examination involving the caregiver or with the caregiver seated in the dental chair holding the child crosswise in the lap. Either method allows the caregiver to visualize the oral examination and to assist in careful restraining of the child's arms and legs.

After assessing the child's dental caries risk, the dentist can recommend appropriate interventions. Most children will be in the low-risk category and require only an initial oral debridement with a toothbrush. The use of a disclosing agent will afford the opportunity to assess oral hygiene skills and the need for instruction and assist in supporting the suggested recall interval. Following the oral debridement, the application of a fluoride varnish using a disposable brush is equal to or more effective and less time consuming than the traditional application of a fluoride gel using disposable trays. For low risk children, the recommended recall interval can be 12 months.

For high-risk children, the same procedures will be used, but the child will be appointed for additional interventions, therapeutic treatments, or more frequent fluoride varnish application.

#### Protocol: Primary and Mixed Dentitions

1. The dentist is the primary provider for the very young child. For the older child the dental assistant or dental hygienist would be the primary provider. Greet the caregiver, introduce yourself, and ask the caregiver if they have any current oral health concerns regarding their child and determine if the home water comes from a well.
2. Invite the caregiver to accompany their child to the examination area.
3. Inform the caregiver about the new evidence-based knowledge regarding dental caries, cavitated lesions, and new concepts for preventive interventions.
4. Depending on the size and compliance of the preschool child, the dentist can use a knee-to-knee positioning technique, have the caregiver sit in the dental chair and hold the child in his/her lap, or have the child sit in the dental chair.

For the older child, have the patient sit in the dental chair and invite the caregiver to observe.

5. The dentist will perform an oral assessment to assist in formulating a risk assessment. Observe for the presence of dental restorations, cavitated enamel lesions, and/or demineralized enamel. In addition, observe for visible plaque and oral pathology. Depending on the compliance of the child, perform a complete head and neck examination. For the older child, use a disclosing solution to assist in caregiver oral hygiene education.
6. Based on the HealthPartners Dental Group (HPDG) risk assessment protocol, the dentist will perform a risk assessment.
7. If low risk, inform caregiver of the child's current risk assessment, provide information on oral hygiene and diet, perform a toothbrush prophylaxis using toothpaste only. Recommend a one-year recall interval.
8. For the very young child at moderate or high risk, the dentist will inform caregiver of the child's current risk assessment, provide information on oral hygiene and diet, perform a toothbrush prophylaxis using fluoride toothpaste, and apply fluoride varnish using a Bend-a-brush. Recommend a 3-6 month recall interval. If cavitated enamel lesions require restoration, appoint for restorative procedures or refer to a pediatric dentist.

   For the older child at moderate or high risk, the dentist will inform the caregiver of the child's current risk assessment and provide information on oral hygiene and diet. The dental assistant will perform a toothbrush prophylaxis using fluoride toothpaste and apply fluoride varnish using a Bend-a-brush. A 3-6 month recall is recommended. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) can be used to assist in remineralization. If cavitated enamel lesions require restoration, appoint for restorative procedures.

**Caries Risk**

**Protocol: Permanent Dentition**

1. The dental hygienist is the primary provider. Greet the patient, introduce yourself, and ask the patient if they have any oral health concerns.
2. Radiographs are taken per dentist orders in electronic dental records (EDR) or in compliance with the Collaborative Agreement.
3. Patient is escorted to the treatment room and the medical and dental histories are reviewed and entered into EDR. For patients 18 years and older, blood pressure is taken and recorded in the health history.
4. For patients new to HPDG, existing restorations are recorded in EDR. Full mouth periodontal probings are recorded for all patients 18 years and older. For patients under the age of 18, periodontal probing should be conducted if the radiographs suggest bone loss. Obvious findings can be discussed with the patient as a primer for the dentist's examination.
5. The dentist is advised that an exam can now be conducted on the patient. The dentist reviews the patient's history, radiographs and periodontal recordings. The dentist then conducts a detailed soft and hard tissue examination relaying any findings to the dental hygienist to record in EDR.
6. Based on the findings in the examination, the dentist determines a caries, periodontal, and oral cancer risk level and advises the patient of their various risk levels. This information, along with recommended interventions is

recorded in EDR under the risk tab. Recall intervals for dental hygiene and dentist examination visits are established along with any orders for new radiographs. A treatment plan for periodontal therapy and/or restorative care is developed, if indicated.

7. The dental hygienist discusses risk factors along with recommended interventions in detail with the patient as the hygiene visit continues. The patient is given a copy of the Dental Health Risk Summary at the end of the appointment.

**Caries Risk Assessment**

Identifying and assessing groups and individuals at high risk for developing new dental caries allows determination and development of appropriate and effective prevention strategies. Caries risk assessment is an emerging, developing science. Various methods for assessing risk exist, and no single model predominates. Methods that take multiple factors into account achieve greater accuracy for predicting risk of dental caries, more so among groups than among individuals. In the clinical setting, more complex models do not improve on a dentist's perception of risk after examining a patient and considering his/her personal health practices.

Population groups at increased risk of dental caries are members of families of low socioeconomic status (SES) or low levels of parental education; those seeking dental care on an irregular basis, and persons without dental insurance or access to dental service. Persons can be at high risk of dental caries even if they do not belong to a high-risk group; individuals can be a low risk of caries, even if they belong to a high-risk group. Individual level factors thought to contribute to increased risk are: currently active dental caries; caries in the recent past; a history of high caries experience in older siblings or caregivers; exposed root surfaces (where the gums have receded); high levels of infection with cariogenic bacteria; impaired ability to maintain oral hygiene; malformed enamel or dentin; inadequate exposure to fluoride; reduced salivary flow due to medications, radiation treatment, or disease; low salivary buffering capacity (decreased ability of saliva to neutralize plaque acids); a diet conducive to dental caries (i.e., high in refined carbohydrates that are consumed frequently throughout the day); and wearing space maintainers, orthodontic appliances, or dental prostheses. Caries experience in the last 2 to 3 years is the single best predictor of future disease but the results are improved by considering other factors. Children having caries in their primary teeth were three times more likely to develop caries in their permanent teeth (relative ratio = 2.6, 95% confidence interval [CI] = 1.4 to 4.7; $p < 0.001$). Caries on primary molars had the highest predictive value (85.4%).

Caries is a bacterial disease with multiple factors that affect the ability for the bacteria to produce the disease. *Mutans streptococcus* and lactobacillus (LB) are the bacteria associated with dental caries. Recent research has shown caries can develop in the absence of *mutans streptococcus* and that low pH non-*mutans streptococcus* may also be cariogenic. Actinomyces have been shown to be involved in root caries. Therefore, the risk for disease can change over time. Other factors besides past caries experience need to be considered in assessing future caries risk.

*Diets* high in refined carbohydrates clearly increase the risk for future caries. However, no reliable quantitative data exists that can be used to assign risk based

on dietary analysis. Diets that have frequent exposures to refined carbohydrates create an increased risk of caries. Asking about the frequency and types of snacks, lozenges, or beverages the patient consumes during the day is a useful tool for diet assessment. If the caries experience is already significant, this dietary screening can help explain why the caries has occurred, and lead the dentist to recommend a dietary change for the patient. Dentists also want to screen for a new dietary habit that may put the patient at an elevated risk in the future. If a habit of frequent sugar consumption during the day has recently developed, the dentist might consider placing the patient at a higher risk level until the behavior is altered (see Appendix C in the original guideline document).

A *plaque control record* does not help assign risk because dentists do not know what types of bacteria are present. A plaque control record is helpful as a tool to measure patients' efforts and effectiveness at home plaque removal, but not as a predictor of future disease. Bacterial tests could be considered to assess the bacteria present in plaque. Simple in office tests are available to measure the presence of mutans streptococcus and lactobacillus in saliva. These tests have several limitations, especially when dealing with a multifactor disease. Having the bacteria without other factors does not result in caries. Also, studies have shown that caries can be initiated in the absence of mutans streptococci. Therefore bacterial tests are not recommended at this time to assess caries risk. The tests are more helpful at monitoring patient compliance than predicting caries.

Patients who have *xerostomia* due to radiation therapy to the head and neck area or Sjogren's Syndrome should be considered at high risk of future caries. Also, patients who are taking medications with a known side effect of xerostomia should be considered at an elevated risk. Subjective complaints are not reliable. Unstimulated salivary flow appears to have more impact on remineralization potential for root surface caries than stimulated saliva. Sialometric methods are cumbersome. The following questions are recommended:

- Does your mouth feel dry when eating a meal?
- Do you sip liquids to aid swallowing any foods?
- Do you have difficulty swallowing any foods?
- Does the amount of saliva in your mouth seem to be too little, too much or you do not notice it?
- Is your speaking ability affected?

The dentist should consider the following factors when evaluating the patient's answers:

- Do you notice clinical signs (such as dry lips)?
- Does the mouth mirror stick to the oral mucosa?
- Is there a lack of a pool of saliva in the floor of the patient's mouth?
- Is there difficulty expressing saliva from the major salivary ducts?
- Does the mucosa appear dry?
- Is there an increase in caries in an unusual location (example: mandibular incisors)?
- Does the patient have any systemic condition?
- Is the patient taking medications with known xerostomic side-effect?
- Has the patient received or will the patient receive radiation of the head and neck?

- Does the patient have sufficient hydration?

Caries risk assessment should also consider localized areas at greater risk. For example, children experience caries more commonly on surfaces with pits and fissures. Areas of open margins or overhangs are also at greater risk. Older individuals with gingival recession experience more root caries. The preventive strategy used should consider the areas at greatest risk for future caries. Placement of orthodontic bands or low levels of fluoride in a child's drinking water also increase caries risk. These factors are not good predictors of future cares but they do tell dentists something about host susceptibility. If host susceptibility is elevated, the dentist may consider increasing the risk level and/or apply specific preventive interventions such as sealants that can reduce risk.

The best predictor of future disease is past disease. Dentists can look at past disease in two ways: collective lifelong experience and recent experience. Recent caries experience is the best predictor and should be used whenever the information is available. This is measured by looking at the number of caries lesions in the last three years. Dentists can look at a lifelong caries experience when data on recent caries experience is not available. Tracking decayed, missing, and filled teeth is a way to measure the patient's collective caries experience. This overall experience should take the age of the patient into consideration.

The goal of risk assessment is to better identify patients at risk of future caries, identify risk factors and to intervene appropriately to reduce future disease. The risk assessment tools presented are good predictors of future disease but the dentist should keep in mind that risk assessment is not an exact science.

**Radiologic & Clinical Examination for Dental Caries**

**Occlusal Caries**

There is a recommendation from caries researchers that examining pits and fissures with a sharp explorer is not necessary. Histological evidence shows that the explorer can disrupt incipient caries, and bacteria can be moved from groove to groove by a sharp explorer. Current evidence is much less clear that these findings have a clinical significance. The facts are that a sharp explorer can miss important areas of caries better detected by other methods and lead to a false positive diagnosis of caries when not present.

Close visualization of pit and groove areas for discoloration under the enamel is essential for pit and fissure diagnosis. Teeth must be clean, dry, and well illuminated to be properly evaluated. With the greater exposure to fluorides and more frequent placement of sealants deep caries can exist without a visible indication. Radiographs, in the past considered of limited use in the detection of occlusal caries, have been shown to be valuable in detecting deep dentin caries beneath pit and fissures and sealants.

**Proximal Caries**

Proximal radiographs provide a good representation of caries in enamel and dentin. When exposed in a consistent fashion regarding angulation they can provide an indication of whether a lesion is progressing or not. Film holding devices are valuable in producing consistent radiographic exposures, and should be used whenever possible. Visualization of the tooth looking for clinical cavitation and marginal ridge discoloration is an important adjunct to radiographic examination. Transillumination of the tooth is a valuable adjunct when recent films are not available, but provides no additional diagnostic yield beyond that afforded by radiograph. An evaluation of risk is a required part of the prescription of a radiographic recall interval.

The radiographic examination recommendations presented are based on the U.S. Food and Drug Administration (FDA) recommendations found in Guidelines for Prescribing Dental Radiographs (see Appendix A in the original guideline document). This guideline was developed by a panel of experts to optimize patient care by presenting patient selection criteria based on signs, symptoms, and history of the individual patient, rather than using the "routine" intervals that have historically been the norm for prescribing dental radiographs. The recommendations are meant only as a guide and may be customized by the dentist to satisfy the individual needs of the patient in a given situation. As an example, specific monitoring of an early carious lesion would be appropriate at other intervals.

As the patient's caries risk level increases, the need for timely clinical dental examination increases. As the patient complies with prescribed treatments and interventions (fillings, sealants, chlorhexidine [CHX], fluoride [Fl], diet modification, etc.) they should move to a lower caries risk level. Over time the patient would be less likely to develop new or recurrent dental caries, thus the clinical dental exam interval could be lengthened.

Using criteria based on the caries risk level helps to ensure that patients will not be exposed to unnecessary ionizing radiation and that the radiographs that are taken will have significant diagnostic value. Intervals for clinical examination are lengthened as the dentist has gathered information that indicates the caries risk is reduced.

When a caries lesion is identified, it should be further categorized by depth relative to the pulp, how rapidly the lesion is progressing, and whether the lesion is cavitated or non-cavitated. A lesion is amenable to remineralization if it has not progressed more than a third of the way into the dentin, is non-cavitated (organic matrix is intact), and slow progressing. Recurrent caries around restorations is not amenable to remineralization; therefore these previously listed criteria are not applicable. The restoration should either be repaired or replaced.

Determining whether a lesion is cavitated can be difficult but a darker, more opaque appearance to the lesion often indicates cavitation. Depth is best monitored by bite wing (BW) radiographs. Periodic radiographs are often necessary to monitor whether the lesion is progressing over time. Note that a lesion can take 3 or more years to progress significantly in a low or moderate risk patient. Lesions must be monitored over time to determine if they have progressed (demineralization), remineralized, or arrested. Progressing enamel

caries typically have a chalky appearance, with none of the sheen that characterizes an undisturbed or remineralized surface.

Studies conclude that both radiographic and clinical examinations are necessary for accurate diagnosis of dental caries. As the caries risk level for a patient moves toward low risk, the indicated frequency for radiographic and clinical examination decreases. Conversely, as the patient moves toward high caries risk level, the need for radiographic and clinical examination increases. The interval between each type of examination (radiographic or clinical) remains independent of the other. The recommendations presented are based on the need for caries diagnosis only.

**Early (Incipient) Caries**

Diagnosis of small lesions and non-cavitated demineralized areas present a particularly difficult challenge for the dentist. Current diagnostic methods are relatively insensitive for this purpose. Determination of the patient's caries risk based on past caries experience and current lifestyle factors is the logical first step in the diagnostic process. Properly exposed radiographs can detect proximal lesions that are only 1/3 of the way through the enamel. Use of rectangular collimation and a film holding device can be beneficial by reducing the penumbra effect and providing a consistent exposure angle. Digital radiographic techniques may also improve the detection of early caries since the images acquired are digital and can be processed or analyzed to enhance diagnostic performance.

Careful visual inspection of well-dried tooth surfaces is useful in detecting discolored and demineralized areas of enamel and cementum. Incipient enamel caries lesions look whiter than the surrounding sound enamel because of the strong scattering of light within the lesion. Use of magnification can be especially helpful in assessing the integrity of the tooth surface.

Diagnosis of early root caries presents a difficult challenge for the dentist. Texture is the best method to determine root caries activity. When judging texture, the explorer is held with a light grasp and the tip is moved across the surface. Avoid forceful poking into the surface to determine consistency. There is unanimous agreement in the literature that discoloration of the root surface is indicative of caries. Yellow or light brown color is generally active. Shiny and dark is generally inactive. Radiographs are useful in detecting interproximal root surface lesions. As root caries can progress at a rapid rate, early identification is critical if remineralization strategies are to be successful.

There are several emerging diagnostic techniques that appear to offer some promise in the detection of early dental caries. Fluorescence from laser light can be used to detect the difference between sound and demineralized enamel. The two products available are DIAGNOdent and quantitative light-induced fluorescence (QLF)-clinic. These systems have good positive predictive value (PPV) and negative predictive value (NPV) in high risk populations, but unacceptably large numbers of false positives are possible in moderate and low risk populations. Concerns center around the confounding effects of stain, plaque and fluorosis on lesion depth. Further research is needed to address these and other concerns.

Fiber-optic transillumination (FOTI) has sufficient evidence to support its uses for detection of interproximal lesions. So far there are only in vitro studies supporting its use for occlusal surfaces. Clinical studies are needed.

Digitally imaging fiber-optic transillumination (DIFOTI) is a more recent development that combines fiber-optic transillumination with a digital intraoral camera. The images are displayed on a computer screen where it can be compared to the clinical presentation. Only limited in vitro studies are available to support this approach even though it is commercially available.

Electrical conductivity tools have been developed for clinical use to detect occlusal caries. They show high sensitivity but low specificity resulting in significant risk of patients receiving inappropriate restorations.

No single caries detection method can be used on all surfaces under all circumstances. If the goal is monitoring interproximal lesions without radiographs, FOTI or DIFOTI are appropriate. QLF is also well suited to monitor lesions. These tools should be used only as an adjunct to clinical decision making regarding preventive treatment plans in conjunction with caries risk assessment. Their value is in early caries diagnosis, and care should be exercised in order to avoid premature restorations of caries lesions.

**Therapy for Remineralization**

**Overview**

The scientific evidence demonstrates that dentists can remineralize early caries lesions. This is achievable if the lesion is non-cavitated and adequate fluoride is available at the tooth surface. Factors such as bacterial load and frequent exposure to carbohydrates that demineralize the tooth need to be modified. Fluorides are considered to be the primary treatment for remineralization. Chlorhexidine and xylitol are supportive therapies that further modify factors in the caries process.

**Diagnostic Criteria for Active versus Inactive Carious Lesions**

*Interproximal*: No change on a radiograph in three years is considered inactive.

*Smooth Surface*: Chalky white is active. Shiny white is inactive.

*Root surface*: Yellow or brown color and soft is active. Shiny and dark is inactive.

**Fluoride Therapy Based on Caries Location**

The location of the carious lesion often dictates the preferred fluoride vehicle. The compliance of the patient may also influence the choice of fluoride. The success of the procedure is thought to be related to the frequency that the fluoride is applied, so patient adherence to the regimen is critical.

*Root Caries*: For incipient lesions, utilize a high dose fluoride gel or paste applied by the patient two times per day. At all clinic visits (including hygiene and restorative) a fluoride varnish should be considered.

*Interproximal Caries*: For all incipient lesions no deeper than the dentino-enamel junction (DEJ) utilize frequent low dose fluoride 4-6 times per day. Utilize fluoride rinses and toothpaste at strategically planned intervals throughout the day. At all clinic visits (including hygiene and restorative) a fluoride varnish should be considered.

*Other Smooth Surface Caries*: Frequent low dose fluoride (rinses and over-the-counter [OTC] toothpaste 4-6 times a day is the best approach). For low compliance patients add in a fluoride varnish every 3 months. At all clinic visits (including hygiene and restorative) a fluoride varnish should be considered.

*Pits and Fissures*: Morphology of the pits and fissures don't lend themselves to remineralization therapy. Sealants are the treatment of choice. (See sealant section of this guideline.)

**Additional Therapies**

*Diet modification* is important in remineralization. The key goal is reduction of between meal snacks and beverages that are caries promoting.

*Chlorhexidine* is indicated when caries progression is rapid. If you see a measurable change in lesion size or several new lesions develop since the prior examination, bacterial counts are likely high. The regimen commonly recommended is .5 ounces twice a day for 14 days. The medication can be repeated in 3 months if the disease is still active or the patient isn't compliant with diet modifications.

*Xylitol* gum or mints are indicated for individuals with dry mouth, frequent snacking, gum or candy use. Xylitol can significantly reduce caries progression if used for five minutes 3-4 times a day after meals and snacks. Look for products where xylitol is the primary sweetener. Xylitol products have been shown to retard bacterial growth after chlorhexidine therapy. Ideally, at least 4 grams of Xylitol should be consumed daily.

*CPP-ACP* is indicated for patients with high caries rates. Ideal application is using custom made fluoride trays. Exposure for 4-5 minutes after normal home care before bed (and ideally a second time during the day) is most beneficial. Since it is safe to swallow, Australian practitioners have recommended a pea sized amount be placed on teeth before patient goes to sleep. This would not be removed and allowed to work while the patient is sleeping. This technique has also been suggested for pediatric patients. Avoid using this with patients allergic to milk products.

**Monitoring Interval**

Individuals with several risk factors for progression, evidence of rapid progression or concerns about compliance, and patients new to HealthPartners should be seen

at 3-6 month intervals. Six-month follow-up is indicated for patients established in the practice with prior radiographs and no evidence of rapid progression. For patients where the lesion hasn't progressed in 3 years, a 1 year follow-up interval may be indicated.

Radiographs are typically the best method to evaluate interproximal lesions. A bitewing radiograph is recommended every 6 months for the first two years and yearly if the lesion hasn't progressed.

**Maintenance**

Successful remineralization therapy is generally defined as no progression in three years. Thereafter the recall intervals and radiograph intervals should be based on the patient's risk level. Caries interventions for the maintenance stage should be based on the overall caries risk. One example that would be appropriate for discontinuing the remineralization therapy would be the person who has significantly improved their dietary practices and oral hygiene. If either the diet or oral hygiene is still of concern or other risk factors remain, continuation of the fluoride supplement and other therapies is indicated.

**Management of Rampant Caries**

With increasing frequency, new patients present to the clinic with extensive dental caries, often complaining of pain. In these cases it is not unusual to learn it has been many years since the patient's last dental visit and that the patient only seeks care when in pain. In addition to the situation described above, dentists have a number of patients of record who only seek dental care when in pain yet have multiple areas of dental decay. The first priority of the examining dentist is to address pathology that is causing discomfort. This may take the form of extraction of hopeless teeth, endodontic therapy or decay removal from the offending tooth with the placement of a suitable temporary filling material. It is important to assess the patient's understanding of their oral condition by asking if they know what is causing their pain and what they can do to address the disease condition. This is also an appropriate time to ask the patient their view of the importance of oral health and what they would like dentists to do for them.

After addressing the patient's chief complaint, the treating dentist should determine if the patient has an interest in addressing their oral health care needs. If the patient expresses interest, a complete inventory of dental caries by tooth and surface needs to be made as well as a complete periodontal assessment. Periodontal concerns are addressed by gross debridement and extraction of hopeless teeth. A thorough review of the patient's medical history may shed light on factors that are contributing to the disease process. For example, diabetes may be a cause of the patient's periodontal problems or the patient may be on a medication that is causing xerostomia contributing to rampant caries. Patients with extensive dental disease are often non-compliant with attendance at scheduled dental appointments and in making the behavior and lifestyle changes necessary to maintain a healthy dentition. Prochaska's Behavior-Change Model (Appendix B in the original guideline document) is a useful tool to assess the patient's willingness to make the changes required for improved oral health, including regular dental visits. Patient education about the dental disease process is a vital element of the initial comprehensive assessment. The chances for a

successful outcome of dental care improve when the patient is engaged as an active participant in their care. The patient must take ownership of their oral condition, not the dentist, if long term success is to be expected.

Dental caries is a bacterial infectious process and needs to be treated as such. The first goal of the treating dentist is to reduce that oral bacterial burden that is causing the decay. This is accomplished in part by gross removal of most or all of the carious tooth structure. To reach this goal in the most expeditious time frame, it may be necessary to schedule the patient in a manner that allows decay removal from a number of teeth at a single appointment and the placement of a temporary restoration such as glass ionomer. Glass ionomers offer a number of advantages as a temporary material including the ability to bond to tooth structure and the release of fluoride. The appointments should allow the maximum number of teeth to be treated (temporized) each visit. This may involve scheduling by quadrant, by arch or by half mouth. In addition to gross decay removal, the dentist should seal unaffected grooves and pits that can serve as a reservoir for decay causing bacteria.

Prior to embarking on a series of appointments designed to eradicate decay and temporize teeth, a candid assessment needs to be made of the long term viability of the teeth and the patient's willingness to invest the time, money, and effort to maintain them. In the long run, it may be more prudent to extract marginal teeth rather than attempt heroic efforts that ultimately result in failure and wasted resources.

There is a natural and understandable tendency on the part of the restoring dentist to want to place permanent restorations in the highly active caries patient at the restorative visit. Dentists must resist this temptation and recognize the fact that this clinical condition developed over a long period of neglect. There is tremendous value in placing glass ionomer restoration using a non-traumatic technique. This approach helps to build the dentist-patient rapport while also addressing the patient's active caries state and building their self-esteem through improved esthetics. Too often recalcitrant patients presenting with deep decay are alienated by experiencing pre and post operative pain associated with deep restorations or pulpal involvement. Placement of glass ionomer temporaries can also pay dividends in improved gingival health prior to placement of permanent restorations. The anterior teeth should be treated last. The presence of decay in the front teeth serves as a reminder to patients that they need to be faithful to their dental appointments. Patients need to be informed of the sequence of care that is planned.

The next step in the treatment of the severely decay challenged patient is the use of short term antimicrobial agents. Fluoride varnishes have been shown to be highly effective as antibacterial agents. Fluoride varnishes are particularly effective for patients with exposed root surfaces. Application of fluoride varnish to the highly caries active patient at each recall and restorative visit is a very cost effective method (from both a time and materials perspective) in the quest to control decay activity. An alternative treatment is short term use of chlorhexidine (CHX) mouthrinse. CHX is very effective against mutans streptococci. The patient should be instructed to rinse for 30 seconds with ½ oz. of CHX twice daily. A two week course of CHX every two-three months assists in controlling the level of mutans streptococci.

A phenomenon encountered with increasing frequency is the young patient presenting for examination with numerous enamel caries without cavitation. Most often the etiology is diet related and patient education is critical. This clinical situation is the precursor to the patient described above and requires the same attention to interventions and recall frequency.

Over the counter fluoride rinses and prescription fluoride toothpastes have been shown to be effective in remineralizing tooth structure. Low dose, frequent exposures to fluoride should be recommended to foster an oral environment that promotes tooth remineralization.

Patients being treated for extensive caries need to be placed on a frequent caries recall protocol. The caries re-exam appointment (code 0120C) provides a useful model to follow. At each recall, necessary radiographs are taken to evaluate for new decay and remineralization of previously diagnosed lesions. An exam is conducted for new areas of decay and failing restorations. This appointment is an ideal opportunity to apply fluoride varnish to exposed root surfaces and other areas that seem vulnerable to new decay.

Once the patient has demonstrated the willingness to attend dental appointments and to engage in the homecare necessary to maintain his/her dentition, permanent restorations can be placed in the temporized teeth. Once the temporized teeth have been permanently restored the patient enters the maintenance phase of care.

**Root Surface Caries**

Proper diagnosis is the first step in treating a root surface lesion. The lesion may be classified as abrasion (a mechanical removal of root structure), erosion (chemical removal of root structure), and idiopathic root resorption, or root surface caries. Active root surface caries (RSC) present as yellow or light brown in color and are relative soft to the explorer. Due to soft nature of cementum, the explorer should not be used aggressively when examining a root surface lesion.

Remineralization is the treatment of choice whenever possible and fluoride is the most effective agent available to accomplish this. Arrested lesions become dark brown to black in color and are hard enough to resist penetration by the explorer. They are generally shiny in color. The Root Surface Caries Severity Index classifies root caries into four grades. Grade I is the incipient lesion treatable by polishing the surface followed by daily application of 1% sodium fluoride gel. Grade II lesions are shallow (<.5 mm) and are treated by recontouring and polishing the surface defect and daily application of fluoride as described above. Grade III lesions are deeper than .5 mm and require restoration. Consideration should be given to a restorative material that is capable of bonding to dentin and cementum and offers the benefit of continuous fluoride release. Amalgam is the second choice for restorative material followed by composites. Grade IV lesions are deep lesions involving the pulp. Treatment may involve pulpal therapy followed by a restoration or extraction.

**Interventions**

**Sealants**

Current literature suggests a risk-based approach to recommending sealants.

*Risk Based Case Selection*

The HealthPartners Dental Group risk model mirrors elements in the literature used to predict the indications for occlusal sealants. Previous occlusal caries experience is the best predictor of future occlusal caries. Children who have caries or restorations in the deciduous teeth are strong candidates for the placement of sealants in the erupting permanent dentition.

*Low Risk Patients*

Sealants are generally not indicated for patients at low risk. Sealants can be placed in low risk situations when a parent or patient requests. Issues of caries risk and of on-going sealant maintenance should be discussed.

There may be indications in individual teeth with deep pits and fissures or stain.

*Moderate and High Risk Children*

Deciduous Teeth

May be indicated when there are deep grooves, or incipient caries.

Newly Erupted Permanent Teeth

Teeth are at greatest risk for occlusal caries when newly erupting. Delay in sealant placement until the tooth is fully erupted may allow progression to frank caries. Difficulties in isolating partially erupted teeth affect sealant retention. Close monitoring of the sealant and touchup of partial sealants is essential for effective caries prevention.

Other Considerations

Sealants are primarily indicated for the first and second molars. Premolars and upper lateral incisors with stain, deep pits and fissures, or incipient enamel lesions should also be considered for sealants.

*Moderate and High Risk Adults*

Specific teeth with stain, deep pits and fissures, or incipient enamel lesions should generally have sealants placed.

Other Considerations

Maintenance

Sealants require regular inspection and maintenance. A partially lost sealant can be more plaque retentive and at the same caries risk of an unsealed surface.

Technique is critical, as a poorly placed sealant is a caries risk liability.

Incipient Lesions

Clinically incipient enamel caries lesions are areas of demineralized, noncavitated enamel without clear evidence of dentinal penetration. A properly placed and maintained sealant prevents the progression of incipient caries.

Buccal and Lingual Surfaces

Sealants are less reliably retained on the buccal and lingual surfaces of teeth. Other treatment may be indicated in situations of anatomical anomalies or incipient lesions of buccal or lingual surfaces.

Behavioral Issues

Sealants are generally not indicated for uncooperative children. They may be used during behavioral conditioning exercise. It is inappropriate to refer children for sealants alone to the pediatric dentist. Alternative materials such as fluoride varnish or glass ionomer can be placed on the occlusal grooves of teeth in uncooperative children.

Other Uses of Sealants

Sealants have been shown to be effective when used over both amalgam and composite restorations, allowing for more conservative operative preparation.

**Recommended Technique for Sealant Application**

*Tooth Preparation*

Clean tooth surface to be sealed with a dry, pointed prophy brush. Enamelplasty and use of pumice are not recommended.

Isolate tooth to keep dry. Rubber dam or cotton roll isolation work well.

*Sealant Technique*

Air dry tooth surface to be etched. Etch tooth surface using a gel phosphoric acid for 15 to 20 seconds. Agitate the gel during the etching process using a microbrush. Be sure to use to sufficient gel to thoroughly etch the surface.

Rinse surface for a minimum of 10 seconds to remove all the etchant.

Air dry surface to a chalky appearance-the surface should be dry.

Apply one application of SingleBond and thin with air (to avoid any pooling). Do not dispense SingleBond until ready to apply to the surface to be sealed (dispense directly on the microbrush then apply to the tooth surface).

Apply sealant and thin with microbrush to avoid pooling.

Cure for 30 seconds.

Check occlusion. If necessary, adjust occlusion with a round bur. Ideally, the sealant will be out of occlusion to minimize stress.

**Fluoride**

*Fluoride and Dental Caries*

Dental caries afflicts the majority of the population in industrialized and developing countries. Fluoride reduces the incidence of new decay and slows the progression of existing lesions. Although pit and fissure sealants, good oral hygiene, and appropriate healthy practices contribute to caries prevention and control, the most effective and widely used approaches have utilized fluorides. Fluoride use is accepted as the main reason for the worldwide decline of dental caries in recent years.

The United States Public Health Service (USPHS) recommended fluoride concentrations for public water supplies were developed in the 1940s and 1950s on the assumption that drinking fluoridated water would provide the major source of fluoride. Since then, processed foods have become a larger proportion of many diets (small amounts of fluoride are also found in many foods and beverages, especially if they are processed with fluoridated water). The success of water fluoridation in caries prevention has led to the development of other fluoride-containing products, such as toothpastes (dentifrices), mouthrinses, dietary supplements, and professionally-applied or prescribed gels and varnishes. Often bottled water contains little or no fluoride.

See the original guideline document for a description of the process by which fluoride prevents dental caries.

*Sources of Fluoride and Their Effects*

Fluoridation of community drinking water and fluoridated toothpaste are the most common sources of fluoride in the United States. Together, they are largely responsible for the low risk status for dental caries enjoyed by many individuals in this country. This section also describes other fluoride modalities such as topical gels, mouthrinses, and dietary supplements that are provided for groups or individuals at moderate or high risk of dental caries, and who thus require more frequent or more concentrated exposure to fluoride than persons at low risk.

Fluoridated Fluids

When fluoridated water is the main drinking water sources used, a low concentration of fluoride is routinely introduced into the mouth. Some of this fluoride is taken up by dental plaque, some is transiently present in saliva, which serves as a reservoir for plaque fluoride, and some is loosely held on the enamel surfaces. Frequent consumption of fluoridated drinking water and products made with fluoridated water maintains the concentration of fluoride in the mouth.

In the U.S., intake of fluids, such as water, soft drinks, and juice, provide approximately 75% of a person's fluoride intake. Many soft drinks, fruit juices, and other beverages are processed in/at locations where the drinking water is fluoridated. In addition, foods and ingredients used in food processing vary in their fluoride content. As consumption of processed beverages by children increases, fluoride intake in communities without fluoridated water may rise if the water source for the processed beverage is fluoridated.

Fluoridated Community Water

Water fluoridation is the controlled addition of a fluoride compound to a public water supply to achieve an optimal fluoride concentration. One researcher originally concluded that 1 ppm fluoride was the optimal concentration for climates similar to the Chicago area; this level would significantly reduce the prevalence of dental caries with an acceptably low prevalence (10% to 12%) of very mild and mild dental fluorosis and no moderate or severe dental fluorosis. Current fluoridation guidelines, which have been maintained by the U.S. Public Health Service since 1962, recommend that community drinking waters contain 0.7 to 1.2 ppm fluoride, depending on the mean maximum daily air temperature of the area. These temperature-related guidelines were based on a series of epidemiological studies conducted during the 1950s that led to the development of an algebraic formula for determining the optimal fluoride concentration for each community. This formula recommended a lower fluoride concentration for communities in warmer climates because persons living there drank more tap water. Social and environmental changes since 1962, such as increased use of air conditioning and more sedentary lifestyles, make it less likely that persons in warmer regions drink more tap water than do their counterparts in cooler regions.

Infant Formulas

A study of fluoride intake among Iowa infants indicated that infant formulas and other baby foods contain variable amounts of fluoride from processing. Extended consumption (beyond 10 to 12 months) of infant formula has been recognized as a risk factor for dental fluorosis, due to the formula fluoride content and additionally when fluoride concentrates are mixed with fluoridated water. Since 1979, U.S. manufacturers of infant formula have voluntarily lowered the fluoride level of their products, both ready-to-feed and concentrate, to <0.3 ppm fluoride. Even so, a small proportion of infants, mainly those receiving all of their nutrition from formula concentrates reconstituted with fluoridated drinking water, may have a daily fluoride intake that exceeds the tolerable upper intake level established to reduce the risk of dental fluorosis. As solid foods are added to a formula diet, the amount of fluoride intake typically decreases. It is not known whether fluoride intake from formula that exceeds recommended levels only during the first 10 to 12 months of life contributes to the prevalence or severity of dental fluorosis.

Fluoridated Toothpaste

Fluoride is the primary nonprescription toothpaste additive that has been shown to prevent caries. When introduced into the mouth, fluoride in toothpaste is taken up directly by demineralized enamel and by dental plaque. Brushing with a fluoride toothpaste also increases the fluoride concentration in saliva by 100- to

1,000-fold, although the concentration drops to baseline levels within 1 to 2 hours. Some of this salivary fluoride is taken up by dental plaque; saliva thus acts as a fluoride reservoir.

By the 1990s, fluoridated toothpaste accounted for >90% of the toothpaste market in the United States, Canada, and other developed countries. Many authorities believe that toothpaste has been the most important source of fluoride globally.

Effect of Fluoridated Toothpaste on Dental Caries

The use of fluoridated toothpaste reduces caries experience by median reductions of 15% to 30% in studies of 2 to 3 years duration. This reduction appears modest compared with the effect of water fluoridation, but the water fluoridation studies usually measured lifetime exposure. Regular lifetime use of fluoride toothpaste likely provides ongoing benefits that may approach those of fluoridated water; a combination of both offers additional protection.

Most persons generally brush twice daily, which was the frequency shown to reduce dental caries in clinical trials. Brushing three times daily would probably maintain a higher average fluoride concentration than would brushing twice daily; however, it is unclear whether switching from twice to three times daily would result in lower caries experience. Brushing twice a day is a reasonable social norm that is both effective and convenient for most persons' daily routines, and it has become a basic recommendation for caries prevention. Because the amount and vigor of rinsing after toothbrushing affects the fluoride concentration in the mouth, adults and children over age six can retain more fluoride in the mouth by either rinsing gently or not at all.

In the United States, the standard concentration of fluoride in fluoridated toothpaste is 1,000 to 1,100 ppm. Toothpaste with 1,500 ppm fluoride has been found slightly more efficacious in studies in Europe and the United States, and some products with this concentration have been marketed in the United States. Although these high-fluoride products are not available in all markets, they may benefit adults and children > age 6 at high risk for dental caries. High-fluoride toothpaste is contraindicated for children ages <6 years because of their increased risk of fluorosis. For preschool aged children, a pea-sized amount of 100 ppm toothpaste is recommended.

Fluoridated Mouthrinses

Fluoridated mouthrinses are concentrated solutions intended for daily or weekly use. The fluoride from rinses, like that from toothpaste, is retained in dental plaque and in saliva to help prevent dental caries. The most common fluoride compound used in mouthrinses is sodium fluoride. Among schoolchildren (age 6 to 16), solutions of 0.05% fluoride for daily rinsing or 0.20% fluoride for supervised weekly rinsing are used. Over-the-counter products (0.05%) are available for daily use at home. Throughout the 1980s, over 3 million children in the United States participated in supervised, school-based fluoride mouth-rinsing programs. The current extent of supervised fluoride mouth-rinsing programs is not known.

Studies that have found that fluoridated mouthrinses reduce caries experience by an average of 31% date mostly from the 1970s and early 1980s. Two studies found benefits of such mouth rinsing 7 years after completion of school-based mouth-rinsing programs, but a third study did not find such benefits at 4 years after completion of the program. The National Preventive Dentistry Demonstration Program (NPDDP), a large project conducted in 10 U.S. cities between 1976 and 1981 to compare the costs and effectiveness of combinations of preventive procedures, found that the effectiveness of fluoride mouth rinsing among schoolchildren was poor, both in first-grade students with high and low caries experience and in all schoolchildren as a group. The NPDDP documented that only a limited reduction in dental caries was attributable to fluoride mouthrinsing as children's exposure to fluoride from other sources increased.

Use of fluoridated mouthrinses by persons >6 years of age does not place them at risk for fluorosis, because they are beyond the age of concern for cosmetically objectionable fluorosis of teeth that are visible. Children < age 6 years should not use fluoridated mouthrinses without prior consultation with their dentist, because dental fluorosis could occur if swallowed repeatedly.

Fluoride Supplements

Fluoride supplements in the form of tablets, lozenges, drops, and fluoride-vitamin preparations have been used around the world since 1940s. An estimated 16% of children in the United States aged <2 years use fluoride supplements. Most supplements contain sodium fluoride as the active ingredient. Tablets and lozenges are manufactured with a fluoride content of 1.0, 0.5, or 0.25 mg.

In the United States, a dentist or physician must prescribe fluoride supplements. The prescription should be consistent with the dosage schedule developed jointly by the American Dental Association (ADA), the American Academy of Pediatric Dentistry (AAPD), and the American Academy of Pediatrics (AAP). Because fluoride supplements are intended to compensate for fluoride-deficient water, the dosage schedule requires knowledge of the fluoride content of the child's drinking water.

A pre-eruptive systemic effect of fluoride supplements cannot be completely ruled out; however, no direct evidence of such an effect has been demonstrated. There are no systematic reviews or meta-analysis of the effectiveness of fluoride supplements in the literature. The effect of fluoride has shifted from one of systemic action to those of topical effects on the enamel. Use of fluoride supplements by pregnant women does not benefit their offspring.

| **Fluoride Supplement/Day (mg)**<br>Concentration of fluoride ion in drinking water (in ppm) | | | |
|---|---|---|---|
| Age | <0.3 | 0.3 to 0.6 | >0.6 |
| 0 – 6 mo. | 0 | 0 | 0 |
| 6 mo. – 3 yrs. | 0.25 | 0 | 0 |
| 3 – 6 yrs. | 0.50 | 0.25 | 0 |

| **Fluoride Supplement/Day (mg)** Concentration of fluoride ion in drinking water (in ppm) | | | |
|---|---|---|---|
| Age | <0.3 | 0.3 to 0.6 | >0.6 |
| 6 – 16 yrs. | 1.00 | 0.50 | 0 |

Professionally Applied Fluoride Compounds

Dentists have been applying high-concentration fluoride compounds in the form of gels or varnish directly to patients' teeth for more than fifty years. Application procedures were developed on the assumption that the fluoride would be incorporated into the crystalline structure of the dental enamel and develop a more acid-resistant enamel. To maximize this reaction, a professional tooth cleaning was previously considered mandatory before the application. Subsequent research, however, has shown that high-concentration fluoride compounds, such as gels, do not directly enter the enamel's crystalline structure. Instead, the compound forms a "calcium fluoride-like" reservoir on the enamel's surface that releases fluoride for remineralization when the pH in the mouth drops. Professional tooth cleaning is unnecessary solely to prepare the teeth for fluoride application; toothbrushing and flossing appear to be equivalent in improving the efficacy of high-concentration fluoride compounds.

Fluoride Gels

Fluoride gels are available with sodium fluoride (NaF), stannous (SnF), and acidulated phosphate fluoride (APF). The concentration of fluoride varies depending on the type of fluoride and they are all about equally effective. Most dentists use NaF or APF fluoride. Sodium fluoride has documented antibacterial affects, and should be used with patients with xerostomia or undergoing radiation therapy.

The most common high-concentration fluoride compound used in the United States is a 1.23% (12,300 ppm) fluoride gel, usually sodium fluoride. Because an early study showed that fluoride uptake by dental enamel is greater in acidic environment, fluoride gel is often made to be highly acidic (pH approximately 3.0). APF is not recommended for patients with porcelain or composite restoration as they may become etched. Other available products include sodium fluoride (0.5% fluoride or 5,000 ppm) or stannous fluoride (0.15% fluoride or 1,000 ppm). Stannous fluoride can cause staining and the taste may be objectionable to some.

Clinical trials conducted during the 1940s to the 1970s demonstrated that professionally-applied fluoride gel was effective in reducing dental caries experience; semi-annual treatments resulted in an average decrease of 26% in caries experience in permanent teeth of children in non-fluoridated areas. The application time in these studies was 4 minutes. The optimal schedule for repeated topical fluoride applications has not been adequately studied to support definitive guidelines and studies have shown mixed results; the usual recommended frequency based on available evidence is semi-annual.

A prophylaxis prior to application of a topical fluoride is not necessary. In most circumstances the use of prophylaxis paste is contraindicated as it removes the

fluoride-rich outer layer of enamel. The topical fluoride is applied with the use of a tray and should be left in the mouth for four minutes. (One minute fluoride gel is not as effective.) Patients should not eat or drink for 30 minutes after application. Fluoride gels should be provided at every recall appointment for patients at moderate or high risk for dental decay.

| **Water F Level** | **Caries-Free** | **Active Caries** | **Rampant Caries**</thead< |
|---|---|---|---|
| Deficient (<0.7 ppm) | Apply topical<br><br>2x per year | Apply topical<br><br>2x per year | Apply topical<br><br>4x per year |
| Optimal | Not recommended | Apply topical<br><br>2x per year | Apply topical<br><br>4x per year |

Fluoride Varnishes

High-concentration fluoride varnishes are painted directly onto the teeth. These varnishes are not intended to adhere permanently; rather, they are a method of holding a high concentration of fluoride in a small amount of material in close contact with the teeth for an extended period. They are available as sodium fluoride (2.26% fluoride or 22,600 ppm) preparations. Fluoride varnishes have been widely used in Canada and Europe since the 1970s to prevent dental caries. Research on fluoride varnish, such as optimal fluoride concentration, the most effective application protocols, and its efficacy relative to other fluoride modalities, is likely to continue both in Europe and North America. Studies examining the effectiveness of varnishes have been approved by the U.S. Food and Drug Administration (FDA) as a cavity liner (to provide fluoride at the junction of filling material and tooth) and root desensitizer (to reduce sensitivity to temperature and touch that sometimes occur on root surfaces that have been exposed by receding gums); to date the FDA has not approved an anticaries claims for these varnishes.

Studies conducted in Canada and Europe has found that fluoride varnish is efficacious in preventing dental caries. Applied semi-annually, this modality is as effective as professionally applied fluoride gel. Varnishes also have been shown to prevent demineralization, a very early stage of dental caries, beneath orthodontic bands and to slow the progression of existing enamel lesions. Some researchers advocate application of fluoride varnish up to four times per year to achieve maximum effect, but the evidence of benefits from more than two applications per year remains inconclusive. Three applications in 1 week, once per year, may be more effective than the more conventional twice-per-year regimen. There is no evidence to suggest that professionally applied fluoride varnish is a risk factor for dental fluorosis; proper application technique reduces the possibility that the patient will swallow excess varnish. Fluoride varnish tends to separate into its components while in the package. Therefore, it is recommended to use the single use fluoride varnish that can be mixed in the delivery well prior to application.

Self Applied Fluoride Gels

Fluoride gels for home use are available only by prescription. Self applied fluoride gels contain a high level of fluoride (up to 0.5 percent fluoride) and should only be recommended to patients who can master the technique. The gel should be brushed on at intervals as prescribed by the dentist. The patient should not eat or drink for 30 minutes after application. An option for post head and neck radiation patients or patients with very high caries activity is to apply the gel through the use of a tray. It should be used on a regular basis until the patient can be reassessed at the next recall appointment. Some patients (i.e., patients with radiation induced xerostomia) may need prescription fluorides indefinitely. After the caries process is demonstrably controlled most high risk patients can be effectively maintained using a fluoride mouth rinse and fluoridated toothpaste.

**Chlorhexidine**

The presence and number of MS (*mutans streptococci*) micro-organisms is directly correlated to a cariogenic environment that increases the incidence of root and enamel caries.

It is well established that the efficacy of chlorhexidine (CHX) as an anti-microbial rinse, significantly reduces existing MS, prevents formation of new plaque and selectively suppresses growth of MS which in turn reduces caries incidence.

The effectiveness of CHX lies in its substantivity property. Substantivity is the ability to keep an agent in contact with an organism long enough to kill or disable an organism.

**Recommended Regimen**

One 16 ounce bottle of CHX is prescribed to maintain an intensive, short term treatment to a therapeutic end point.

The patient uses 1/2 ounce, 30 second rinse twice daily. (Should not be used within 1/2 hour after brushing as the bonding between the toothpaste and CHX inhibits effects.) The salivary flow diminishes to nearly zero overnight, therefore concentration in the mouth remains high. The amount of time CHX remains in contact with MS, prolongs effectiveness. With a 7 day regimen MS in saliva will be suppressed for up to three months. Suppression may not be uniform in all locations in the mouth.

Side effects:

- Staining of teeth and restorations
- Increased calculus deposits
- Approximately 11% alcohol

Patient compliance is necessary for successful treatment. To monitor compliance and a therapeutic end point, a 3 to 4 month recall is suggested.

**Xylitol**

Xylitol is a five carbon sugar alcohol that is not a fermentable substrate for *mutans streptococci* (MS). It has the same agreeable taste as sucrose and appeals to children. Xylitol's anti-cariogenic properties have been demonstrated in numerous studies, and several are highlighted below. Some studies have not only shown decay reductions in new caries, but also an actual reversal of minimal lesions.

The essence of how xylitol works is that the MS lose a competitive advantage in the oral ecosystem when exposed to adequate quantities of xylitol. In other words, it allows less virulent species to predominate.

Alternative sweeteners such as xylitol and sorbitol have been evaluated to determine if they can have a positive effect on caries prevention.

One way in which they have been tested is to determine the effect a sugar substitute may have on remineralization in initial caries through reflex stimulation of salivary flow. Salivary flow is stimulated as a result of masticatory and gustatory (sweet) stimuli.

Chewing xylitol gum, especially after eating, produces a masticatory and gustatory effect, increasing the salivary flow. Increased salivary flow maintains or restores a high level of pH in the mouth that can have a remineralizing effect on initial caries and inhibit the amount of demineralization on other surfaces. Another study on the incidence of caries in relation to a one-year consumption of xylitol chewing gum showed "a profound difference in the caries increment rate between the two experimental groups. The findings clearly indicate a therapeutic, caries inhibitory effect of xylitol." The caries incidence in the control group, as measured in decayed/missing/filled surface index (DMFS), was 2.92 and in the experimental group was -1.04.

The use of sugarless mints that contain xylitol as the primary sweetener is also an effective method of modifying plaque acidogenic challenges. Another study found that children who used a fluoride toothpaste containing a xylitol-sorbitol mixture had a significantly lower caries increment over three years compared with those who used a similar product containing sorbitol alone.

It should be noted that xylitol has an effect that sorbitol and other sugar substitutes do not have. Xylitol is not metabolized by the bacteria, while sorbitol is metabolized but to a lesser degree than sucrose. Xylitol needs to be taken in amounts of at least 4 grams daily to have an anticaries effect. It may cause loose stools in some patients. Xylitol can be used as a sugar substitute thus decreasing the consumption of fermentable carbohydrates.

Mothers can lower the risk of their young children developing caries by having the mother chew xylitol sweetened gum or use xylitol sweetened mints, for 5 minutes after meals or snacks, three times per day during the time their child is 6 months old to age 18 months.

**Casein Phosphopeptide-Amorphous Calcium Phosphate**

The concept of saturating the environment immediately surrounding the tooth with calcium phosphate in order to preserve tooth structure is a very logical one. Many attempts have been made and multiple products are available that attempt this. The challenge has been the instability of calcium phosphate. The combination of casein phosphopeptides (CPP) and amorphous calcium phosphate (ACP) overcomes this challenge. CPP's are derived from milk products. The protective and anticariogenic effects of these proteins have been well documented. A reduction in the Strep sobrinus population in oral microbiota of animals fed diets supplemented with these milk products has been consistently observed. It has also been demonstrated that a combination of CPP-ACP will incorporate well into the salivary pellicle. It has been observed that this combination not only significantly reduces the adherence of Strep sobrinus but that of Strep mutans as well. The CPP's also stabilize and enhance the ACP allowing a higher concentration of calcium phosphate in the salivary pellicle and plaque. This supersaturation of calcium phosphate buffers the acid and protects against demineralization while enhancing remineralization. Researchers in Australia have demonstrated that enamel remineralized by CPP-ACP is more resistant to caries. They have also observed an improved remineralization of white spot lesions. It should be noted, however, that all the research has been done in *in situ* models (i.e., in disks of enamel mounted in special carriers in the palate). No long-term studies using caries as the endpoint have been published. CPP-ACP is indicated for active ortho patients, patients with removable appliances, patients with root exposure (thus at risk for root caries), xerostomia and other risk factors. It has also been reported that patients experience less sensitivity when consistently using the CPP-ACP. Because of its non-toxic status, it can also be used for patients of all ages and pregnant women. It is however contraindicated for patients who have allergies to milk proteins.

Suggested Protocol (not based on any published studies):

- Patients at moderate or high risk for caries: Apply with finger or toothbrush before bed after brushing with fluoride toothpaste.
- Patients with uncontrolled caries or xerostomia: Apply using a custom tray (leave tray in for 3 to 4 minutes) before bed after brushing with fluoride toothpaste.

### CLINICAL ALGORITHM(S)

The following clinical algorithms are provided in the original guideline document:

- Caries Risk Assessment – Mixed Dentition
- Primary and Mixed Dentition
- Caries Risk – Permanent Dentition
- Remineralization
- Root Surface Caries

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting the recommendations is not specifically stated.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

- Accurate assessment of caries risk
- Appropriate use of interventions that reduce risk of dental caries and the need for restorations
- Reduction of the incidence of caries

### POTENTIAL HARMS

- Side effects of chlorhexidine include:
    - Staining of teeth and restorations;
    - Increased calculus deposits
    - Approximately 11% alcohol
- Xylitol may cause loose stools in some patients.
- Stannous fluoride (SnF, found in fluoride gels) can cause staining and the taste may be objectionable to some.
- A partially lost sealant can be more plaque retentive and at the same caries risk of an unsealed surface. Technique is critical, as a poorly placed sealant is a caries risk liability.

## CONTRAINDICATIONS

### CONTRAINDICATIONS

- Casein phosphopeptide amorphous calcium phosphate (CPP-ACP) is contraindicated for patients who have allergies to milk proteins.
- High-fluoride toothpaste is contraindicated for children ages <6 years because of their increased risk of fluorosis.
- Children < age 6 years should not use fluoridated mouthrinses without prior consultation with their dentist, because dental fluorosis could occur if swallowed repeatedly.

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

- The risk assessment tools presented are good predictors of future disease but the dentist should keep in mind that risk assessment is not an exact science.
- The radiographic examination recommendations presented are based on the Food and Drug Administration (FDA) recommendations found in Guidelines for Prescribing Dental Radiographs (Appendix A in the original guideline document). This guideline was developed by a panel of experts to optimize patient care by presenting patient selection criteria based on signs, symptoms, and history of the individual patient, rather than using the "routine" intervals that have historically been the norm for prescribing dental radiographs. The recommendations are meant only as a guide and may be customized by the dentist to satisfy the individual needs of the patient in a

given situation. As an example, specific monitoring of an early carious lesion would be appropriate at other intervals.
- The recommendations for prescribing dental radiographs, in Appendix A in the original guideline document, are subject to clinical judgment and may not apply to every patient. They are to be used by dentists only after reviewing the patient's health history and completing a clinic examination. The recommendations do not need to be altered because of pregnancy.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

### IMPLEMENTATION TOOLS

Chart Documentation/Checklists/Forms
Clinical Algorithm

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Getting Better
Staying Healthy

### IOM DOMAIN

Effectiveness
Patient-centeredness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

HealthPartners Dental Group and Clinics caries guideline. Minneapolis (MN): HealthPartners Dental Group; 2008 Mar 31. 60 p. [328 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

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## GUIDELINE DEVELOPER(S)

HealthPartners Dental Group - Professional Association

## SOURCE(S) OF FUNDING

HealthPartners Dental Group

## GUIDELINE COMMITTEE

Not stated

## COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Not stated

## FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

## GUIDELINE STATUS

This is the current release of the guideline.

## GUIDELINE AVAILABILITY

Electronic copies: None available

Print copies: Available from HealthPartners, 8170 33rd Avenue South, P.O. Box 1309, Minneapolis, MN 55440-1309; Phone: (952) 883-5151; Web site: http://www.healthpartners.com

## AVAILABILITY OF COMPANION DOCUMENTS

Appendix C in the original guideline document contains a caries risk assessment tool.

## PATIENT RESOURCES

None available

## NGC STATUS

This NGC summary was completed by ECRI Institute on October 16, 2008. The information was verified by the guideline developer on October 27, 2008.

## COPYRIGHT STATEMENT

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